BUPERS: $7,500 EACH

Drawing of July 15–16, 1964: Eleanor G. Gale, 7 Paula Road, Mattapan 26, Mass.

Drawing of July 29–30, 1964: Richard A. Dougherty, 9 Oak Street, Dover, N.H.

Drawing of September 9, 1964: Jean Eric Raupack, 210 Clifton Street, Houston, Tex.; Henry Turcotte, 252 Wight Street, Berlin, N.H.; Minnie Kennedy, Gloversville, N.Y.; Dave and Jennie Powell, 63 Off Station Street, East Weymouth, Mass.

GUN BOAT: $7,500 EACH

Drawing of July 15–16, 1964: Jack Ross, 139 Hawthorne Street, Chelsea, Mass.

Drawing of July 29–30, 1964: Cecile M. Therrien, 241 Joliette Street, Manchester, N.H.

Drawing of September 9, 1964: Shirley and Murray Weiner, 1052 Barbey Street, Brooklyn, N.Y.; Albert J. Betley, Dorothea Betley, 187 Holly Avenue, Manchester, N.H.; Lucy, Brenda, Walter, Walter Lewis, 3 Walter Street, Salem, Mass.; Robert McBurnie, 43 Ruth Ann Terrace, Milford, Conn.

RAMANT: $7,500 EACH

Drawing of July 15–16, 1964: Joseph Acavel, Playland Park, Rye, N.Y.,

Drawing of July 29–30, 1964: Violet and Albert Zierak, and family, 66 Van Derveer, Amsterdam, N.Y.

Drawing of September 9, 1964: Paul J. Schwalen, 4 Wyman Avenue, Portchester, N.Y.; Salvatore A. Zagarella, 219 Gladstone Street, East Boston, Mass.; B. Carmody, 8 Bradstreet, Avenue, Revere, Mass.; Al King, 145 Elwood Avenue, Newark, N.J.

OLD STONEY: $7,500 EACH

Drawing of July 15–16, 1964: Erma Bartlett, 34 Grand Street, Hartford, Conn.

Drawing of July 29–30, 1964: Mildred McLain, 55 Ruggles Street, Quincy, Mass.

Drawing of September 9, 1964: Mary Kowalczuk, 63 Rosemont Avenue, Manchester, N.H.; Stan Stanfel and family, 2401 16th Street, San Francisco, Calif.; Christian and Karola Ott, 2453 Morgan Avenue, Bronx 69, N.Y.; Penn Florentino, P. C. Florentino, 14 Chisholm Street, Everett, Mass.

PHANTOM SHOT: $7,500 EACH

Drawing of July 15–16, 1964: Conrad J. Ducharme, 37 Prescott Street, Nashua, N.H.

Drawing of July 29–30, 1964: Joseph M. Russo, 522 Market Street, Marcus Hook, Pa.

Drawing of September 9, 1964: Mr. and Mrs. William K. Augur, 1172 Quinnipiac Avenue, New Haven, Conn.; Mr. Stanley Lipiko, 1680 Commonwealth Avenue, Brighton, Mass.; Harry Betheil and A. Savitch, 150 East 182d Street, Bronx, N.Y.; Emma Chabot, 18 Hawthorne Street, Norwich, Conn.

PRAIRIE SCHOONER: $7,500 EACH

Drawing of July 15–16, 1964: John Smith, 215 Alberta Drive, Saddle Brook, N.J.

Drawing of July 29–30, 1964: E. T. Sellers and Ethel, 68 Eastern Way, Rutherford, N.J.

Drawing of September 9, 1964: Joe and Janice Gluchacki, 371 Renaud Street, Fall River, Mass.; Mrs. Harold Duffy, 19 Powell Street, Florence, Mass.; Mort Barlett, 230 Fairfield Avenue, Hartford, Conn.; Patricia Beirne, 20 Leach Lane, Natick, Mass.

KNIGHTLY MANNER: $50,000 EACH

Drawing of July 15–16, 1964: G. D. Kelly, 432 Jefferson Street, Ridgewood, N.J.

Drawing of July 29–30, 1964: Carol Ann Lee, 17 Schussler Road, Worcester, Mass.

Drawing of September 9, 1964: A. Pernokas, 14 Proctor Circle, Peabody, Mass.; Mrs. Margery L. Johnson, 8 Beacon Street, Attleboro, Mass.; Josie and John DeGregory, Rural Delivery No. 1, Saratoga Springs, N.Y.; Anne Brzezicki, 15 Locust Road, Ipswich, Mass.

PURSER: $25,000 EACH

Drawing of July 15–16, 1964: Ralph Muzzy, RFD No. 1, Derry, N.H.

Drawing of July 29–30, 1964: Mrs. Anna Dmitruk and others, 1101 Smith Street, Newmarket, N.J.

Drawing of September 9, 1964: L. C. Lunde, 30 Merrymount Street, Wollaston, Mass.; Leo Gabrukiewicz, 1117 Stark Street, Utica, N.Y.; Virginia and Edith Grund, 55 Cherry Street, Somerville, Mass.; Jimmie and Gussie Zwelman, 5 Fargo Street, Baldwin, Long Island, N.Y.

National Security and the Nuclear Test Ban

OSI file

EXTENSION OF REMARKS

OF

HON. JOSEPH S. CLARK

OF PENNSYLVANIA

IN THE SENATE OF THE UNITED STATES

Saturday, October 3, 1964

Mr. CLARK. Mr. President, I ask unanimous consent to have printed in the Appendix of the RECORD, the newspaper account entitled "Arms Race Called Road to Oblivion," which appeared in the Washington Post of September 24 and an article from the October 1964 edition of Scientific American entitled "National Security and the Nuclear Test Ban," by Jerome B. Wiesner and Herbert F. York.

There being no objection, the articles were ordered to be printed in the RECORD, as follows:

[From the Washington (D.C.) Post, Sept. 24, 1964]

ARMS RACE CALLED ROAD TO OBLIVION—SCIENCE EXPERTS SAY NO FURTHER BUILDUP CAN PRESERVE NATION

(By Howard Simons)

Two former key Government science advisers say in a detailed study that a further buildup in weaponry is virtually meaningless, as no conceivable military efforts can any longer safeguard a nation's security.

The two scientists are Jerome B. Wiesner and Herbert F. York, who give their views in a 9-page article to be published in the October issue of the Scientific American.

Wiesner was science adviser to the late President Kennedy and is now dean of science at the Massachusetts Institute of Technology. York was chief scientist at the Pentagon during the Eisenhower and Kennedy administrations and now is chancellor of the University of California at San Diego.

The essence of their thesis is that both sides in an arms race are "confronted by the dilemma of steadily increasing military power and steadily decreasing national security."

NO TECHNICAL SOLUTION

They further state that "this dilemma has no technical solution" in their "considered professional judgment."

The two scientists, who point out that they have spent their professional lifetimes advising the Government on military policy and in the active development of weapons, make this statement:

"If the great powers continue to look for solutions in the area of science and technology only, the result will be to worsen the situation. The clearly predictable course of the arms race is a steady open spiral downward into oblivion."

For these reasons, Wiesner and York argue against continued underground nuclear testing and in favor of further arms control and thereafter "actual disarmament" as a solution to the dilemma.

Whereas the article is cast in scientific and technical terms, it clearly has political implications because aspects of the theme are now part of the political campaign.

JOHNSON ADVISERS

Senator BARRY M. GOLDWATER, particularly, has decried what he contends is the administration's failure to develop new weapons systems. Moreover, Wiesner is a prime mover and charter member of "Scientists and Engineers for Johnson and HUMPHREY." Wiesner is also a member of President Johnson's bipartisan Science Advisory Committee, as is York.

Basing their arguments on nonsecret information, Wiesner and York conclude that neither antimissile missiles nor fallout and blast shelters nor further refinements in atomic and hydrogen weapons can protect Americans or Russians against the ravages of nuclear-tipped-missile warfare.

Arguing that "defense against thermonuclear attack is impossible," Wiesner and York dismiss the idea that fallout and blast shelters can provide a significant solution to the problem of national survival. They maintain that calculations on the percentage of population that would be saved in a sheltered society is unknowable because the form of nuclear attack is unknowable.

Moreover, the big problem in their view is not the physical theory of reducing radiation but the "sociological problem of the sudden initiation of general chaos, which is not subject to numerical analysis."

The two scientists question the effectiveness of an anti-missile-missile system as a technical solution to the problem of preserving a nation from nuclear devastation. They cite the case of the Nike-Zeus, which was intended to be an American anti-missile-missile system capable of intercepting and destroying nuclear warheads before they could rain down upon the Nation.

At the time of the conception of the Nike-Zeus system, the scientists say, its designers were confronted with a comparatively simple problem, "namely that of shooting down the warheads one by one as they presented themselves to the detectors."

But what happened, according to Wiesner and York, is that the offense outran the defense. The designers of the offense began to build penetration aids "mock weapons, decoys, single rockets that eject multiple warheads—devices and stratagems that "overwhelmed the designed capability of the Nike-Zeus system and compelled its recent abandonment."

Wiesner and York suggest, too, that a similar fate befell the Sage system designed in the 1950's to protect the Nation against a thermonuclear attack by bombers. Essentially, they say, the offense against which these systems were planned changes before the defense system can be fully developed.

Nonetheless, the scientists do note interim benefits from continuing efforts to develop defense systems, even though "nothing on the horizon suggests that there is a solution" to the antimissile problem. One such benefit, in their view, is that this kind of research "promotes the continued development of offensive weapons."

They explain that:

"The practical fact is that work on defensive systems turns out to be the best way to promote invention of the penetration aids that nullify them."

In making their case for an end to all nuclear weapons testing, Wiesner and York tick off the reasons advanced by others for testing and dismiss each in turn.

Thus, they view the military usefulness of superbombs, such as the 100-megaton weapon that Premier Khrushchev has boasted is in the Soviet arsenal, as impractical. Such a weapon, they say, would be expensive and "under any imaginable circumstances it would be of limited use and not many of its kind would be built." Moreover, they contend that the United States has the know-how to develop such a superbomb without further testing.

As for the neutron bomb or pure fusion bomb, publicized by some persons as capable of killing people but leaving property intact, Wiesner and York argue that even if its development were simple the major powers would want to slow its development. The reason would be that such a theoretical weapon could be made by the "smallest and poorest powers in the world."

INFORMATION MARGINAL

In sum, Wiesner and York conclude that, although further testing would contribute some additional refinement to and knowledge of nuclear weapons, such as the effect of blast and radiation on material, "the information would be, at best, marginal."

Moreover, the scientists feel other considerations to be far greater uncertainties than the knowledge of weapons effects. Among these considerations they listed: How good are the potential enemy's missiles; will he strike cities or military bases or both; what kind of attack will he launch?

Just such an uncertainty, they say, manifested itself in the famous missile gap controversy of the 1960 presidential campaign.

Rather than continued nuclear testing, which does little to resolve these uncertainties in the view of Wiesner and York, they suggest that the Nation could improve its nuclear capability by improving the accuracy and reliability of its missiles in order to be more certain of delivering atomic warheads on their targets.

In want of a scientific and technical solution to the problem of defending the United States against nuclear attack, the Nation has evolved a strategy whose aim is to have a capability to destroy or threaten to destroy enemy targets even after absorbing the first nuclear punch.

"Several approaches, in fact," says Wiesner and York, "can be taken to assure the survival of a sufficient missile force after a first attack on it. The most practical of these are: 'hardening'; that is, direct protection against physical damage; concealment, including subterfuge and, as in the case of the Polaris submarine missiles, mobility; and numbers; that is, presenting more targets than the attacker can possibly cope with."

Numbers, according to Weisner and York, is the most straightforward and certain of these missile race tactics. They maintain that by any measure the combination of smaller warheads and greater numbers of missiles provides the greatest assurance for the Nation's deterrent force to survive and wreak revenge and even win, whatever that may mean.

Essentially, the two weapons specialists argue that since both the United States and the Soviet Union have had for some time and do have the capability of destroying one another and, since science and technology cannot prevent such destruction, the only solution lies at the disarmament conference table.

[From the Scientific American, October 1964]

NATIONAL SECURITY AND THE NUCLEAR TEST BAN

(By Jerome B. Wiesner and Herbert F. York)

The partial nuclear test ban—the international treaty that prohibits nuclear explosions in the atmosphere, in the oceans, and in outer space—has been in effect for a little more than a year. From July 1945, when the first atomic bomb was set off in New Mexico, until August 1963, when the United States completed its last series of atmospheric bomb tests in the Pacific, the accumulated tonnage of nuclear explosions had been doubling every 3 years. Contamination of the atmosphere by fission products and by the secondary products of irradiation (notably the long-lived carbon 14) was approaching a level (nearly 10 percent of the natural background radiation) that alarmed many biologists. A chart plotting the accumulation of radioactive products can also be read as a chart of the acceleration in the arms race.

Now, for a year, the curve has flattened out. From the objective record it can be said that the improvement of both the physical and the political atmosphere of the world has fulfilled at least the short-range expectations of those who advocated and worked for the test ban. In and of itself the treaty does no more than moderate the continuing arms race. It is nonetheless, as President Kennedy said, "an important first step—a step toward peace, a step toward reason, a step away from war."

The passage of a year also makes it possible to place in perspective and evaluate certain misgivings that have been expressed about the effect on U.S. national security of the suspension of the testing of nuclear weapons in the atmosphere. These misgivings principally involve the technology of nuclear armament. National security, of course, involves moral questions and human values—political, social, economic, and psychological questions as well as technological ones. Since no one is an expert in all the disciplines of knowledge concerned, it is necessary to consider one class of such questions at a time, always with the caution that such consideration is incomplete. As scientists who have been engaged for most of our professional lifetimes in consultation on this country's military policy and in the active development of the weapons themselves, we shall devote the present discussion primarily to the technological questions.

The discussion will necessarily rest on unclassified information. It is unfortunate that so many of the facts concerning this most important problem are classified, but that is the situation at this time. Since we have access to classified information, however, we can assure the reader that we would not have to modify any of the arguments we present here if we were able to cite such information. Nor do we know of any military considerations excluded from open discussion by military secrecy that would weaken any of our conclusions. We shall discuss the matter from the point of view of our country's national interest. We believe, however, that a Soviet military technologist, writing from the point of view of the U.S.S.R., could write an almost identical paper.

Today as never before national security involves technical questions. The past two decades have seen a historic revolution in the technology of war. From the blockbuster of World War II to the thermonuclear bomb the violence of military explosives has been scaled upward a million times. The time required for the interhemispheric transport of weapons of mass destruction has shrunk from 20 hours for the 300-mile-per-hour B-29 to the 30-minute flight time of the ballistic missile. Moreover, the installation of the computer in command and control systems has increased their information-processing capacity by as much as six orders of magnitude compared with organizations manned at corresponding points by human nervous systems.

It has been suggested by some that technological surprise presents the primary danger to national security. Yet recognition of the facts of the present state of military technology must lead to the opposite conclusion. Intercontinental delivery time cannot be reduced to secure any significant improvement in the effectiveness of the attack. Improvement by another order of magnitude in the information-processing capacity of the defending system will not make nearly as large a difference in its operational effectiveness.

The point is well illustrated by the 100-megaton nuclear bomb. Whether or not it is necessary, in the interests of national security, to test and deploy a bomb with a yield in the range of 100 megatons was much discussed during the test ban debates. The bomb was frequently referred to as the "big" bomb, as if the bombs now in the U.S. arsenal were somehow not big. The absurdity of this notion is almost enough by itself to settle the argument. A 1-megaton bomb is already about 50 times bigger than the bomb that produced 100,000 casualties at Hiroshima, and 10 megatons is of the same order of magnitude as the grand total of all high explosives used in all wars to date. Other technical considerations that surround this question are nonetheless illuminating and worth exploring.

There is, first of all, the tactics of the missile race. The purpose of a missile system is to be able to destroy or, perhaps more accurately, able to threaten to destroy enemy targets. No matter what the statesmen, military men, and moralists on each side may think of the national characteristics, capabilities, and morality of the other side, no matter what arguments may be made about who is aggressive and who is not or who is rational and who is not, the military planners on each side must reckon with the possibility that the other side will attack first. This means that above all else the planner must assure the survival of a sufficient proportion of his own force, following the heaviest surprise attack the other side might mount, to launch a retaliatory attack. Moreover, if the force is to be effective as a deterrent to a first strike, its capacity to survive and wreak revenge and even win, whatever that may mean, must be apparent to the other side.

Several approaches, in fact, can be taken to assure the survival of a sufficient missile force after a first attack on it. The most practical of these are: (1) "hardening," that is, direct protection against physical damage; (2) concealment, including subterfuge and, as in the case of the Polaris submarine missiles, mobility, and (3) numbers, that is, presenting more targets than the attacker can possibly cope with. The most straightforward and certain of these is the last: numbers. For the wealthier adversary it is also the easiest, because he can attain absolute superiority in numbers. A large number of weapons is also a good tactic for the poorer adversary, because numbers even in the absence of absolute superiority can hopelessly frustrate efforts to locate all targets.

There is an unavoidable trade-off, however, between the number and the size of weapons. The cost of a missile depends on many factors, one of the most important being gross size or weight. Unless one stretches "the state of the art" too far in the direction of sophistication and miniaturization, the cost of a missile turns out to be roughly proportional to its weight, if otherwise identical design criteria are used. The protective structures needed for hardening or the capacity of submarines needed to carry the missile also have a cost roughly proportional to the volume of the missile. Some of the ancillary equipment has a cost proportional to the size of the missile and some does not; some operational expenditures vary directly with size or weight and some do not. The cost of the warhead generally does not, although the more powerful warhead requires the larger missile. It is not possible to put all these factors together in precise bookkeeping form, but it is correct to say that the cost of a missile, complete and ready for firing, increases somewhat more slowly than linearly with its size.

On the other hand—considering hard targets only—the effectiveness of a missile increases more slowly than cost as the size of the missile goes up. The reason is that the radius of blast damage, which is the primary effect employed against a hard target, increases only as the cube root of the yield and because yield has a more or less direct relation to weight. Against soft targets, meaning population centers and conventional military bases, even small bombs are completely effective, and nothing is gained by increasing yield. Given finite resources, even in the wealthiest economy, it would seem prudent to accept smaller size in order to get larger numbers. On any scale of investment, in fact, the combination of larger numbers and smaller size results in greater effectiveness for the missile system as a whole, as contrasted to the effectiveness of a single missile.

This line of reasoning has, for some years, formed the basis of U.S. missile policy. The administration of President Eisenhower, when faced with the choice of bigger missiles (the liquid-fueled Atlas and Titan rockets) as against smaller missiles (the solid-fueled Minuteman and Polaris rockets), decided to produce many more of the smaller missiles. The administration of President Kennedy independently confirmed this decision and increased the ratio of smaller to larger missiles in the Nation's armament. During the test ban hearings it was revealed that the U.S. nuclear armament included bombs of 23-megaton yield and higher, carried by bombers. Recently Cyrus R. Vance, Under Secretary of Defense, indicated that the Air Force has been retiring these large bombs in favor of smaller ones. There are presumably no targets that call for the use of such enormous explosions.

The argument that says it is now critical for U.S. national security to build very big bombs and missiles fails completely when it is examined in terms of the strictly technical factors that determine the effectiveness of a missile attack. In addition to explosive yield the principal factors are the number of missiles, the overall reliability of each missile, and the accuracy with which it can be delivered to its target. The effectiveness of the attack—the likelihood that that a given target will be destroyed—can be described by a number called the kill probability (P_k). This number depends on the number of missiles (N) launched at the target, the reliability (r) of each missile and the ratio of the radius of damage (R_k) effected by each missile to the accuracy with which the missiles are delivered to the target (CEP). The term "CEP," which stands for "circular error probable," implies that the distribution of a large number of hits around a given target will follow a standard error curve; actually, for a variety of reasons (which include the presence of systematic errors, coupling between certain causes of error and the sporadic nature of the larger error factors) the distribution does not really follow a standard error curve. The term "CEP" is still useful, however, and can be defined simply as the circle within which half of a large number of identical missiles would fall.

Now, in the case of a soft target, R_k is very large for the present range of warhead yields in the U.S. arsenal. The reason is that soft targets are so highly vulnerable to all the "prompt" effects (particularly the incendiary effects) of thermonuclear weapons. The range of these effects, modified by various attenuation factors, increases approximately as the square root or the cube root of the yield at large distances. Under these circumstances, given the accuracy of existing fire-control systems, the ratio R_k/CEP is large and the likelihood that the target will be destroyed becomes practically independent of this ratio. Instead P_k depends primarily on r, the reliability of the missile. If r is near unity, then a single missile ($N=1$) will do the job; if r is not near unity, then success in the attack calls for an offsetting increase in the number of missiles [$P_k=1-(1-r)^N$]. In either case changes in R_k make little difference. That is to say, a big bomb cannot destroy a soft target any more surely than a small one can.

When it comes to hard targets, the ratio R_k/CEP becomes much smaller even for bombs of high yield. The blast effects—including the ground rupture, deformation and shock surrounding the crater of a surface burst—have comparatively small radii at intensities sufficient to overcome hardening. Moreover, as mentioned above, the radii of these effects increase only as the cube root of the yield. This rule of thumb is modified somewhat in both directions by the duration of the blast pulse, local variations in geology and other factors, but it is sustained by a voluminous record from weapons tests. Since the radius of blast damage is of the same order of size as the circular error probable, or smaller, the ratio R_k/CEP must be reckoned within an attack on a hard target. Yet even in this situation the cube root of a given increase in yield would contribute much less to success than a comparable investment in numbers, reliability or accuracy.

Nuclear explosions in the atmosphere from 1945 to 1962, the last full year in which the United States and the U.S.S.R. set off such explosions, are presented on the basis of accumulated megatons. The overall increase in megatons has doubled every 3 years. The data for this chart are from Federal Radiation Council Report No. 4:

Accumulated megatons exploded in the atmosphere

	Megatons
1945–51	0.76
1952–54	61
1955–56	89
1957–58	174
1959–60	174
1961	294
1962	511

Yield is of course a product of the yield-to-weight ratio of the nuclear explosive employed in the warhead multiplied by the weight of the warhead. In order to gain significant increases in the first of these two quantities further nuclear tests would be necessary. Increase in the weight of the warhead, on the other hand, calls for bigger and more efficient missiles. In the present state of the art, efforts to improve CEP and reliability as well as weight-carrying capacity hold out more promise than efforts to improve the yield-to-weight ratio. The reason is that missile design and control involve less mature and less fully exploited technologies than the technology of nuclear warheads. Finally, an increase in the number of missiles, although not necessarily cheap, promises more straightforward and assured results than a fractional increase in yield-to-weight ratio. Of all the various possible technical approaches to improving the military effectiveness of an offensive missile force, therefore, the only one that calls for testing (whether underground or in the atmosphere) is the one that offers the smallest prospect of return.

Suppose, however, a new analysis, based on information not previously considered, should show that it is in fact necessary to incorporate the 100-megaton bomb in the U.S. arsenal. Can this be done without further weapons tests? The answer is "yes." Because the U.S.S.R. has pushed development in this yield range and the United States has not, the U.S. 100-megaton bomb might not be as elegant as the Soviet model. It would perhaps weigh somewhat more or at the same weight would produce a somewhat lower yield. It could be made, however, and the basic techniques for making it have been known since the late 1950's. The warhead for such a bomb would require a big missile, but not so big as some being developed by the National Aeronautics and Space Administration for the U.S. space-exploration program. Such a weapon would be expensive, particularly on a per-unit basis; under any imaginable circumstances it would be of limited use and not many of its kind would be built.

The extensive series of weapons tests carried out by the United States—involving the detonation of several hundred nuclear bombs and devices—have yielded two important bodies of information. They have shown how to bring the country's nuclear striking force to its present state of high effectiveness. And they have demonstrated the effects of nuclear weapons over a wide range of yields. Among the many questions that call for soundly based knowledge of weapons effects perhaps none is more important in a discussion of the technical aspects of national security than: What would be the result of a surprise attack by missiles on the country's own missile forces? Obviously, if the huge U.S. investment in its nuclear armament is to succeed in deterring an attacker, that armament must be capable of surviving a first strike.

A reliable knowledge of weapons effects is crucial to the making of rational decisions about the number of missiles needed, the hardening of missile emplacements, the degree of dispersal, the proportion that should be made mobile and so on. The military planner must bear in mind, however, that such decisions take time—years—to carry out and require large investments of finite physical and human resources. The inertia of the systems is such that the design engineer at work today must be concerned not with the surprise attack that might be launched today but rather with the kind and size of forces that might be launched against them years in the future. In addition to blast, shock, and other physical effects, therefore, the planner must contend with a vast range of other considerations. These include the yields of the various bombs the attacker would use against each target; the reliability and accuracy of his missiles; the number and kind of weapons systems he would have available for attack; the tactics of the attacker, meaning the number of missiles he would commit to a first strike, the fractions he would allocate to military as against civilian targets and the relative importance he would assign to various kinds of military targets, the effects of chaos on the defender's capacity to respond, and so on. In all cases the planner must project his thinking forward to some hypothetical future time, making what he can of the available intelligence about the prospective attacker's present capabilities and intentions. Plainly all these "other considerations" involve inherently greater uncertainties than the knowledge of weapons effects.

The extensive classified and unclassified literature accumulated in two decades of weapons tests and available to U.S. military planners contains at least some observations on all important effects for weapons with a large range of yields. These observations are more or less well understood in terms of physical theories; they can be expressed in numerical or algebraic form, and they can be extrapolated into areas not fully explored in the weapons tests conducted by the United States, for example into the 100-megaton range. As one departs from the precise circumstances of past experiments, of course, extrapolation becomes less and less reliable. Nonetheless, some sort of estimate can be made about what the prompt and direct effects will be under any conceivable set of circumstances.

Consider, in contrast, the degree of uncertainty implicit in predicting the number and kind of weapons systems that might be available to the prospective attacker. Such an uncertainty manifested itself in the famous "missile gap" controversy. The remarkable difference between the dire predictions made in the late 1950's—based as they were on the best available intelligence—and the actual situation that developed in the early 1960's can be taken as indicating the magnitude of the uncertainties that surround the variables other than weapons effects with which the military planner must contend. Moreover, these factors, as they concern a future attack, are uncertain not only to the defender; they are almost as uncertain to the attacker.

Uncertainties of this order and kind defy reduction to mathematical expression. A human activity as complex as modern war cannot be computed with the precision possible in manipulation of the data that concern weapons effects. What is more, the uncertainties about this single aspect of the total problem are not, as it sometimes assumed, multiplicative in estimation of the overall uncertainty. Most, but not all, of the uncertainties are independent of one another. The total uncertainty is therefore, crudely speaking, the square root of the sum of the squares of the individual uncertainties.

In our view further refinement of the remaining uncertainties in the data concerning prompt direct physical effects can contribute virtually nothing more to management of the real military and political problems, even though it would produce neater graphs. Furthermore, if new effects should be discovered either experimentally or theoretically in the future, or if, in certain peculiar environments, some of the now known effects should be excessively uncertain, it will be almost certainly possible to "overdesign" the protection against them. Thus, although renewed atmospheric testing would contribute some refinement to the data on weapons effects, the information would be, at best, of marginal value.

Such refinements continue to be sought in the underground tests that are countenanced under the partial test ban. From this work may also come some reductions in the cost of weapons, modest improvements in yield-to-weight ratios, devices to fill in the spectrum of tactical nuclear weapons, and so on. There is little else to justify the effort and expenditure. The program is said by some to be necessary, for example, to the development of a pure fusion bomb, sometimes referred to as the neutron bomb. It is fortunate that this theoretically possible (stars are pure fusion systems) device has turned out to be so highly difficult to create; if it were relatively simple, its development might open the way to thermonuclear armament for the smallest and poorest powers in the world. The United States, with its heavy investment in fission-to-fusion technology, would be the last nation to welcome this development and ought to be the last to encourage it. Underground testing is also justified for its contribution to the potential peaceful uses of nuclear explosives. Promising as these may be, the world could forgo them for a time in exchange for cessation of the arms race. Perhaps the best rationale for the underground-test program is that it helps to keep the scientific laboratories of the Military Establishment intact and in readiness; in readiness, however, for a full-scale resumption of the arms race.

Paradoxically one of the potential destabilizing elements in the present nuclear standoff is the possibility that one of the rival powers might develop a successful antimissile defense. Such a system, truly airtight and in the exclusive possession of one of the powers, would effectively nullify the deterrent force of the other, exposing the latter to a first attack against which it could not retaliate. The possibilities in this quarter have often been cited in rationalization of the need for resuming nuclear tests in the atmosphere. Here two questions must be examined. One must first ask if it is possible to develop a successful antimissile defense system. It then becomes appropriate to consider whether or not nuclear weapons tests can make a significant contribution to such a development.

Any nation that commits itself to large-scale defense of its civilian population in the thermonuclear age must necessarily reckon with passive modes of defense (shelters) as well as active ones (antimissile missiles). It is in the active mode, however, that the hazard of technological surprise most often lurks. The hazard invites consideration if only for the deeper insight it provides into the contemporary revolution in the technology of war.

The primary strategic result of that revolution has been to overbalance the scales in favor of the attacker rather than the defender. During World War II interception of no more than 10 percent of the attacking force gave victory to the defending force in the Battle of Britain. Attrition of this magnitude was enough to halt the German attack because it meant that a given weapons-delivery system (bomber and crew) could deliver on the average only 10 payloads of high explosive; such a delivery rate was not sufficient to produce backbreaking damage. In warfare by thermonuclear missiles the situation is quantitatively and qualitatively different. It is easily possible for the offense to have in its possession and ready to launch a number of missiles that exceeds the number of important industrial targets to be attacked by, let us say, a factor of 10. Yet the successful delivery of only one warhead against each such target would result in what most people would consider an effective attack. Thus where an attrition rate of only 10 percent formerly crowned the defense with success, a penetration rate of only 10 percent (corresponding to an attrition rate of 90 percent) would give complete success to the offense. The ratio of these two ratios is 100 to 1; in this sense the task of defense can be said to have become two orders of magnitude more difficult.

Beyond this summary statement of the situation there are many general reasons for believing that defense against thermonuclear attack is impossible. On the eve of attack the offense can take time to get ready and to "point up" its forces; the defense, meanwhile, must stay on the alert over periods of years, perpetually ready and able to fire within the very few minutes available after the first early warning. The attacker can pick its targets and can choose to concentrate its forces on some and ignore others; the defense must be prepared to defend all possible important targets. The offense may attack the defense itself; then, as soon as one weapon gets through, the rest have a free ride.

The hopelessness of the task of defense is apparent even now in the stalemate of the arms race. A considerable inertia drags against the movement of modern, large-scale, unitary weapons systems from the stage of research and development to operational deployment. The duration and magnitude of these enterprises, whether defensive or offensive, practically assure that no system can reach full deployment under the mantle of secrecy. The designer of the defensive system, however, cannot begin until he has learned something about the properties and capabilities of the offensive system. Inevitably the defense must start the race a lap behind. In recent years, it seems, the offense has even gained somewhat in the speed with which it can put into operation stratagems and devices that nullify the most extraordinary achievements in the technology of defense. These general observations are expensively illustrated in the development and obsolescence of two major U.S. defense systems.

Early in the 1950's the United States set out to erect an impenetrable defense against a thermonuclear attack by bombers. The North American Continent was to be ringed with a system of detectors that would flash information back through the communications network to a number of computers. The computers were to figure out from this data what was going on and what ought to be done about it and then flash a series of commands to the various interceptor systems. In addition to piloted aircraft, these included the Bomarc (a guided airborne missile) and the Nike-Hercules (a ballistic rocket). By the early 1960's this Sage system was to be ready to detect, intercept and destroy the heaviest attack that could be launched against it.

The early 1960's have come and yet nothing like the capability planned in the 1950's has been attained. Why not? Time scales stretched out, subsystems failed to attain their planned capabilities and costs increased. Most important, the offense against which the system was designed is not the offense that actually exists in the early 1960's. Today the offensive system on both sides is a mixture of missiles and bombers. The Sage system has a relatively small number of soft but vital organs completely vulnerable to missiles—a successful missile attack on them would give a free ride to the bombers. As early as 1958 the Department of Defense came to realize that this would be the situation, and the original grand plan was steadily cut back. In other words, the Sage system that could have been available, say, in 1963 and that should have remained useful at least through the 1960's would in principle have worked quite well against the offense that existed in the 1950's.

To answer the intercontinental ballistic missile, the Department of Defense launched the development of the Nike-Zeus system. Nike-Zeus was intended to provide not a defense of the continent at its perimeter but a point defense of specific targets. To be sure, the points were fairly large—the regions of population concentration around 50 to 70 of the country's biggest cities. The system was to detect incoming warheads, feeding the radar returns directly into its computers, and launch and guide an interceptor missile carrying a nuclear warhead into intersection with the trajectory of each of the incoming warheads.

Nike-Zeus was not designed to defend the 1,000 or so smaller centers outside the metropolitan areas simply because there are too many of these to be covered by the resources available for a system so huge and complicated. Nor was the system designed to defend the retaliatory missiles, the security of these forces being entrusted to the more reliable protection of dispersal, concealment, mobility and number. In principle, the defense of a hardened missile silo would have presented by far the simplest case for proof of the effectiveness of Nike-Zeus as advanced by those who contend that such a system can be made to work. There would be no ambiguity about the location of the target of the incoming warhead. By the same token Nike-Zeus might have been considered for the defense of a few special defense posts, such as the headquarters of the Air Defense Command of the Strategic Air Command. These special cases are so few in number, however, that it had to be concluded that the attacker would either blast his way through to them by a concentration of firepower or ignore them altogether.

At the time of the conception of the Nike-Zeus system its designers were confronted with a comparatively simple problem, namely that of shooting down the warheads one by one as they presented themselves to the detectors. Even this simple problem had to be regarded as essentially unsolvable, in view of the fact that a 90-percent success in interception constitutes failure in the inverted terms of thermonuclear warfare. At first, therefore, the designers of the offensive system did not take the prospect of an antimissile system seriously. Then the possibility that the problem of missile interception might be solved in principle gave them pause. Thereupon the designers of the offense began to invent a family of penetration aids, that is, decoys and confusion techniques. The details of these and the plans for their use are classified, but the underlying principles are obvious. They include light decoys that can be provided in large numbers but that soon betray their character as "atmospheric sorting" separates them from the heavier decoys (and actual warheads) that can be provided in smaller numbers to confuse the defending detectors down to the last minute. Single rockets can also eject multiple warheads. Both the decoys and the warheads can be made to present ambiguous cross sections to the radar systems. These devices and stratagems overwhelmed the designed capability of the Nike-Zeus system and compelled its recent abandonment.

If the installation of the system had proceeded according to plan, the first Nike-Zeus units would have been operational within the next year or two. This could have been celebrated as a technical milestone. As a means of defense of a substantial percentage of the population, however, the system would not have reached full operational deployment until the end of the decade. In view of its huge cost the system should then have looked forward to a decade of useful life until, say, the late 1970's. Thus, in inexorable accordance with the phase-lag of the defense, the U.S. population was to be defended a decade too late by a system that might have been effective in principle (although most probably not in practice) against the missiles of the early 1960's.

The race of the tortoise and the hare has now entered the next lap with the development of the Nike-X system as succesor to Nike-Zeus. The Advanced Research Projects Agency of the Department of Defense has been spending something on the order of $200 million a year on its so-called defender program, exploring on the broadest front the principles and techniques that might prove useful in the attempt to solve the antimissile problem. Although nothing on the horizon suggests that there is a solution, this kind of work must go forward. It not only serves the forlorn hope of developing an active antimissile defense but also promotes the continued development of offensive weapons. The practical fact is that work on defense systems turns out to be the best way to promote invention of the penetration aids that nullify them.

As the foregoing discussion makes clear, the problems of antimissile development are problems in radar, computer technology, missile propulsion, guidance and control. The nuclear warheads for the antimissile missile have been ready for a long time for delivery to the right place at the right time. Although it is argued that certain refinements in the existing data about weapons effects are needed, the other uncertainties all loom much larger than the marginal uncertainties in these physical effects. The antimissile defense problem, then, is one in which nuclear testing can play no really significant part.

The pursuit of an active defense system demands parallel effort on the passive defense, or shelter, front because the nature of the defense system strongly conditions the tactics of the offense that is likely to be mounted against it. To take a perhaps far-fetched example, a Nike-Zeus system that provided protection for the major population centers might invite the attackers to concentrate the weight of his assault in ground bursts on remote military installations and unprotected areas adjacent to cities, relying on massive fallout to imperil the population centers. This example serves also to suggest how heavily the effectiveness of any program for sheltering the civilian population depends on the tactics of the attacker. Fallout shelters by themselves are of no avail if the attacker chooses to assault the population centers directly.

In any speculation about the kind of attack to which this country might be exposed it is useful to note where the military targets are located. Most of the missile bases are, in fact, far from the largest cities. Other key military installations, however, are not so located. Boston, New York, Philadelphia, Seattle, San Francisco, Los Angeles (Long Beach), and San Diego all have important naval bases. Essential command and control centers are located in and near Denver, Omaha, and Washington, D.C. The rollcall could be extended to include other major cities containing military installations that would almost certainly have to be attacked in any major assault on this country. The list does not stop with these; it is only prudent to suppose still other cities would come under attack, because there is no way to know in advance what the strategy may be.

The only kind of shelter that is being seriously considered these days, for other than certain key military installations, is the fallout shelter. By definition fallout shelters offer protection against nothing but fallout and provide virtually no protection against blast, fire storms and other direct effects. Some people have tried to calculate the percentage of the population that would be saved by fallout shelters in the event of massive attack. Such calculations always involve predictions about the form of the attack, but since the form is unknowable the calculations are nonsensical. Even for the people protected by fallout shelters the big problem is not a problem in the physical theory of gamma-ray attenuation, which can be neatly computed, but rather the sociological problem of the sudden initiation of general chaos, which is not subject to numerical analysis.

Suppose, in spite of all this, the country were to take fallout shelters seriously and build them in every city and town. The people living in metropolitan areas that qualify as targets because they contain essential military installations and the people living in metropolitan areas that might be targeted as a matter of deliberate policy would soon recognize that fallout shelters are inadequate. That conclusion would be reinforced by the inevitable reaction from the other side, whose military planners would be compelled to consider a massive civilian-shelter program as portending a first strike against them. Certainly the military planners of the United States would be remiss if they did not take similar note of a civilian-shelter program in the U.S.S.R. As a step in the escalation of the arms race toward the ultimate outbreak of war, the fallout shelter would lead inevitably to the blast shelter. Even with large numbers of blast shelters built and evenly distributed throughout the metropolitan community, people would soon realize that shelters alone are not enough. Accidental alarms, even in tautly disciplined military installations, have shown that people do not always take early warnings seriously. Even if they did, a 15-minute early warning provides less than enough time to seal the population into shelters. Accordingly, the logical next step is the live-in and work-in blast shelter leading to still further disruption and distoration of civilization. There is no logical termination of the line of reasoning that starts with belief in the usefulness of fallout shelters; the logic of this attempt to solve the problem of national security leads to a diverging series of even more grotesque measures. This is to say, in so many words, that if the arms race continues and resumes its former accelerating tempo, 1984 is more than just a date on the calendar 20 years hence.

Ever since shortly after World War II the military power of the United States has been steadily increasing. Throughout this same period the national security of the United States has been rapidly and inexorably diminishing. In the early 1950's the U.S.S.R., on the basis of its own unilateral decision and determination to accept the inevitable retaliation, could have launched an attack against the United States with bombers carrying fission bombs. Some of these bombers would have penetrated our defenses and the American casualties would have numbered in the millions. In the later 1950's, again on its own sole decision and determination to accept the inevitable massive retaliation, the U.S.S.R. could have launched an attack against the United States using more and better bombers, this time carrying thermonuclear bombs. Some of these bombers would have penetrated our defenses and the American casualties could have numbered in the tens of millions.

Today the U.S.S.R., again on the basis of its own decision and determination to accept the inevitable retaliation, could launch an attack on the United States using intercontinental missiles and bombers carrying thermonuclear weapons. This time the number of American casualties could very well be on the order of 100 million.

The steady decrease in national security did not result from any inaction on the part of responsible U.S. military and civilian authorities. It resulted from the systematic exploitation of the products of modern science and technology by the U.S.S.R. The air defenses deployed by the United States during the 1950's would have reduced the number of casualties the country might have otherwise sustained, but their existence did not substantively modify this picture. Nor could it have been altered by any other defense measures that might have been taken but that for one reason or another were not taken.

From the Soviet point of view the picture is similar but much worse. The military power of the U.S.S.R. has been steadily increasing since it became an atomic power in 1949. Soviet national security, however, has been steadily decreasing. Hypothetically the United States could unilaterally decide to destroy the U.S.S.R. and the U.S.S.R. would be absolutely powerless to prevent it. That country could only, at best, seek to wreak revenge through whatever retaliatory capability it might then have left.

Both sides in the arms race are thus confronted by the dilemma of steadily increasing military power and steadily decreasing national security. It is our considered professional judgment that this dilemma has no technical solution. If the great powers continue to look for solutions in the area of science and technology only, the result will be to worsen the situation. The clearly predictable course of the arms race is a steady open spiral downward into oblivion.

We are optimistic, on the other hand, that there is a solution to this dilemma. The partial nuclear-test ban, we hope and believe, is truly an important first step toward finding a solution in an area where a solution may exist. A next logical step would be the conclusion of a comprehensive test ban such as that on which the great powers came close to agreement more than once during 10 long years of negotiation at Geneva. The policing and inspection procedures so nearly agreed on in those parleys would set significant precedents and lay the foundations of mutual confidence for proceeding thereafter to actual disarmament.

Summary of Record and Accomplishments of the Committee on Ways and Means During the 88th Congress

EXTENSION OF REMARKS

OF

HON. WILBUR D. MILLS

OF ARKANSAS

IN THE HOUSE OF REPRESENTATIVES

Saturday, October 3, 1964

Mr. MILLS. Mr. Speaker, the Committee on Ways and Means has again completed one of the busiest and one of the most productive periods in its entire history. The jurisdiction of this committee, as is well known, is exceedingly broad and complex, including legislation which affects the day-to-day economics and activities of all of our citizens. During the second session of the 88th Congress just concluded, the committee considered and reported legislation in every major area of its jurisdiction.

To afford some indication of the accomplishments of the committee in each of these major areas during the past 2 years, four major measures stand out as prime examples.

In the field of internal revenue taxation, the Revenue Act of 1964 represents the largest single tax cut in the history of the United States. In addition to this very significant reduction in the burdens carried by the American citizens, the Revenue Act of 1964 made many beneficial changes in the Internal Revenue Code. A second major example in the area of internal revenue taxation is the Interest Equalization Act of 1964, a measure which became necessary to help correct a balance-of-payments deficit and which was put into effect in 1964.

In the field of social security legislation, the committee reported the "Social Security Amendments of 1964," H.R. 11865, which unfortunately due to the controversy over certain amendments added by the other body was not enacted into law. A second major example in the social security field was H.R. 9393, a bill which made it possible for the Department of Health, Education, and Welfare to award disability insurance benefits to many thousands of individuals who otherwise would have been ineligible due to the technical requirements of the existing legislation.

In the field of tariff and custom law, the committee reported H.R. 11253, the "Tariff Classification Act of 1964." Again unfortunately, this measure was not finally enacted into law because of the controversy which arose over amendments added in the other body during the closing days of the second session.

In addition to the above examples, it was necessary for the committee to consider and report legislation in the area of the public debt, specifically bills extending the debt ceiling, and legislation to extend for an additional temporary period of time the excise taxes which normally would expire or be reduced on each June 30.

The foregoing measures indicate the intensive and productive activity of the Committee on Ways and Means, but that should not obscure the fact that the committee also reported and there was enacted into law many additional bills of less major import.

As I have pointed out in the past, and can again state without reservations, the members of the Committee on Ways and Means have devoted themselves diligently and conscientiously to the heavy work of the committee. The members of the committee have been assiduous in pursuing their responsibilities and in the attendance of the meetings of the committee almost daily throughout two sessions. Because of the nature of the work of the committee it was again necessary to conduct many executive sessions for the consideration of the complex measures which the committee had before it. While we as individual members of the committee have of course not always agreed on all of the measures considered by the committee, certainly every member can be justly proud of the work which he has done and the record which he has established.

As I have pointed out on numerous past occasions, it is abundantly clear that the nature of legislation falling within the jurisdiction of the Committee on Ways and Means is quite complex and is of vital importance to each and every American citizen and to our Nation as a whole. It is therefore necessary that our committee must always proceed with great caution, prudence, care and statesmanship in carrying out the legislative responsibilities which we have.

During the course of this Congress the Committee on Ways and Means held public or executive hearings on a total of 59 days, exclusive of executive sessions, and has directly received testimony from more than 645 individuals during those hearings. In addition, comments, recommendations, and statements of views were received for the printed record from many hundreds of other interested persons and organizations. The hearings are printed in 25 volumes covering approximately 9,000 pages of testimony. Table 1, which follows, shows the subject and the details of these hearings:

TABLE 1.—*Hearings held by Committee on Ways and Means, 88th Cong.*

Subject	Number of days	Number of witnesses	Number of pages	Number of volumes
1ST SESS.				
President's 1963 tax message	26	267	4,036	7
Continuation of present debt ceiling	1	3	73	1
Tax features of Land and Water Conservation Fund Act of 1963	1	12	112	1
Public debt ceiling	1	4	75	1
Interest Equalization Tax Act of 1963	4	28	540	1
Temporary increase in debt ceiling	1	2	55	1
Tax treatment of beer concentrate	1	9	127	1
Medical care for the aged [1]	5			
2D SESS.				
Medical care for the aged [2]	5	174	2,502	5
Temporary increase in debt ceiling and extension of certain excise tax rates (executive hearing)	2	2	58	1
Federal excise tax structure	12	144	1,421	6
Total, 88th Cong	59	645	8,999	25

[1] Hearings were then suspended until Jan. 20, 1964. See "Medical care for the aged" under 2d sess.
[2] Resumed from Nov. 22, 1963. There was a total of 10 days of hearings.

In addition to the public hearings, during the course of the 88th Congress the full Committee on Ways and Means met in executive session 166 times.

Of the 15,296 public and private bills and resolutions introduced in the House during the course of this Congress, there was referred to the Committee on Ways and Means a total of 2,163 bills and resolutions in addition to the 51 executive communications. In addition, 17 messages of the President of the United States were on subjects within the jurisdiction of the committee. Of the total of 2,164 such bills and resolutions, there were 916 tax bills, 680 tariff bills, and 453 social security bills, in addition to some 115 bills of a miscellaneous character falling within the committe's jurisdiction. This represents more than one-sixth of all the public bills and resolutions introduced in the House of Representatives in this Congress. Table 2, which follows, sets forth the breakdown of the measures referred to the committee:

TABLE 2.—*Bills and resolutions referred to the Committee on Ways and Means, 88th Cong., by category*

Tax	916
Social security	453
Tariff	680
Miscellaneous	115
Total	2,164

During this Congress, the committee favorably reported to the House of Representatives a total of 77 bills, which breaks down as follows: 25 tax bills, 34 tariff bills, 11 social security bills, and 7 miscellaneous type bills. It should be noted in this connection that it is the practice of the committee to report from time to time omnibus legislation which, statistically, appears as one bill but which in fact may combine the provisions or subjects covered in a large number of individual bills which were pending before the committee. For the further information of the Members, I shall insert at this point table 3 which sets forth the statistics on the status of the bills reported by the committee during this Congress: